

Development and Validation of a Military Training Mental Toughness Inventory

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Abstract

Three studies were conducted in order to develop and validate a mental toughness instrument for use in military training environments. Study 1 ($n = 435$) focused on item generation and testing the structural integrity of the Military Training Mental Toughness Inventory (MTMTI). The measure assessed ability to maintain optimal performance under pressure from a range of different stressors experienced by recruits during infantry basic training. Study 2 ($n = 104$) examined the concurrent validity, predictive validity, and test-retest reliability of the measure. Study 3 ($n = 106$) confirmed the predictive validity of the measure with a sample of more specialized infantry recruits. Overall, the military training mental toughness inventory demonstrated sound psychometric properties and structural validity. Furthermore, it was found to possess good test-retest reliability, concurrent validity, and predicted performance in two different training contexts with two separate samples.

Key Words: mental toughness, military, measure

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47 Mental toughness has been identified by coaches and athletes as one of the most
48 crucial attributes underpinning performance excellence (e.g., Connaughton, Wadey, Hanton,
49 & Jones, 2008; Coulter, Mallet, & Gucciardi, 2010; Jones, Hanton, & Connaughton, 2002).
50 Indeed, Gould, Hodge, Peterson, and Petlichkoff (1993) reported that 82% of coaches cited
51 mental toughness as *the* most important psychological attribute which determined success in
52 wrestling. The research literature on mental toughness has been dominated by qualitative
53 approaches which have significantly shaped our understanding of mental toughness (e.g.,
54 Bull, Shambrook, James, & Brooks, 2005; Connaughton et al., 2008; Coulter et al., 2010;
55 Gucciardi Gordon, & Dimmock, 2009a; Jones et al., 2002). However, some researchers have
56 argued that qualitative methods have become overused (e.g., Andersen, 2011), while others
57 have urged researchers to develop reliable and valid measures of mental toughness (e.g.,
58 Sheard, Golby, & van Wersch, 2009). Further, Hardy, Bell and Beattie, (2013) argue that one
59 of the limitations of adopting qualitative methods is that researchers are unable to
60 differentiate between the causes of mental toughness, processes, outcomes, and other
61 behaviors that are more likely to be correlates associated with mental toughness.

62 There are however some notable exceptions to the qualitative approaches, with
63 several quantitatively derived mental toughness measures having been developed (e.g., the
64 Mental Toughness Inventory (MTI; Middleton, Marsh, Martin, Richards, & Perry, 2004;
65 2005); the Sport Mental Toughness Questionnaire (SMTQ; Sheard et al., 2009); the Mental
66 Toughness Questionnaire -48 (MTQ-48; Clough, Earl, & Sewell, 2002); the Cricket Mental
67 Toughness Inventory (CMTI; Gucciardi & Gordon, 2009). Whilst these various measures of
68 mental toughness have significantly contributed to the mental toughness literature and have
69 gone some way to alleviating the over reliance on qualitative approaches, they are not
70 without their critics (see for example, Gucciardi, Hanton, & Mallet, 2012). Hardy et al.

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71 (2013) argued that whilst the above measures capture a wide array of values, attitudes,
72 cognitions and affect, they do not explicitly capture mentally tough behavior. They further
73 argue that psychological variables may influence mental toughness, or be correlates of it, but
74 that the primary focus of such measures should be on *assessing* the presence or absence of
75 mentally tough behavior. Hardy and colleagues also argue that the use of self-report measures
76 in assessing behaviors may be questionable due to social desirability and self-presentation
77 confounds. To this end, Hardy et al. (2013) developed an informant rated behavior based
78 Mental Toughness Inventory (MTI) in an elite sport context that was underpinned by the
79 following definition, “the ability to achieve personal goals in the face of pressure from a wide
80 range of different stressors” (p. 5). This definition of mental toughness was used to underpin
81 the current research.

82 It is important to note that researchers into the concept of mental toughness are not
83 alone in attempting to solve the dilemma of ameliorating the potential harmful effects of
84 exposure to stress. Several similar, yet subtly different constructs associated with stress
85 exposure have been proposed, defined and operationalized. These include the concepts of
86 hardiness, resilience, and grit. Hardiness is viewed as a relatively stable personality
87 characteristic, which involves courage, adaptability and the ability to maintain optimal
88 performance under exposure to stress. It has been conceptualized as a combination of three
89 attitudes; commitment, control, and challenge, which provide an individual with existential
90 courage and motivation to appraise stressful situations as opportunities for growth (Kobasa,
91 1979; Maddi, 2006; 2007). Hardiness and its core components of, commitment, control and
92 challenge are viewed as fundamental to another similar concept, resilience (Maddi, 2007).
93 Resilience is characterized by the ability to recover from negative emotional experiences and
94 the ability to adapt to stressful situations. Another similar psychological construct proposed
95 by Duckworth, Peterson, and Mathews (2007) which involves striving toward challenges and

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96 maintaining effort and persistence despite adversity, setbacks and failure is termed ‘grit,’ .
97 They define grit as, “*perseverance and passion for long-term goals*” (Duckworth et al., 2007,
98 p. 1087), with the emphasis on long-term stamina, rather than short-term intensity. Kelly et
99 al. (2014) suggest that the concept of grit has obvious utility in the military domain in that it
100 is synonymous with fortitude or courage and the essence of officer cadet development in
101 military academies. Whilst all these psychological concepts describe psychological
102 characteristics that are undoubtedly important in a military context, they differ from the
103 current construct of mental toughness in that, the current research is specifically examining
104 mentally tough ‘behavior’. That is, the ability to maintain goal focus and high levels of
105 performance in the face of different stressors. The concepts of hardiness, resilience and grit
106 are described as a constellation of personality characteristics and are as such typically
107 measured at this level. However, mental toughness in the current research is measured and
108 conceptualized at the behavioral level. That is, whilst the behaviors will be to some extent
109 underpinned by personality, the level of measurement is not personality per se. This is an
110 important distinction that will help to further the mental toughness literature by offering a
111 means by which the personality and behavior relationship can be examined. Indeed, Hardy et
112 al. (2013) demonstrated that the current definition of mental toughness was underpinned by
113 Gray & McNaughton’s (2000) revised Reward Sensitivity Theory (rRST).

114 Hardy et al.’s. (2013) MTI has been shown to have good psychometric properties,
115 strong test-retest reliability and successfully discriminate between professional and non-
116 professional athletes. A particular strength of the MTI (which sets it apart from other
117 conceptualizations of mental toughness), is that it was conceptualized within a
118 neuropsychological theoretically driven framework, namely Gray & McNaughton’s (2000)
119 revised Reward Sensitivity Theory (rRST). rRST was used as it has the potential to offer a
120 neuropsychological explanation of the maintenance of goal directed behavior in the face of

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146 **Method**147 **Stage 1: Item Development**

148 Item development was underpinned by the behaviorally based approach adopted by
149 Hardy et al. (2013). Environmental stressors were identified by conducting focus groups with
150 recruit instructors and senior military personnel. An item pool representative of typical
151 stressors experienced by recruits in training (e.g., feeling fatigued, being reprimanded,
152 pressure to perform well, etc.) was developed by the authors, which were then presented back
153 to the recruit instructors for further refinement. This resulted in a 15 item pool.

154 **Participants and Procedure**

155 A total of 279 infantry recruits ($M_{age} = 21.45$, $SD = 3.16$) who were between 5 and 24
156 weeks of training ($M = 14.18$ weeks, $SD = 7.11$) were reported on by 41 male infantry recruit
157 instructors who had served for an average of 9.03 years in the Army ($SD = 2.35$) and had
158 spent an average of 11.78 months as an instructor ($SD = 5.89$). In order for the instructors to
159 accurately assess the recruits, a minimum of 5 weeks supervision was set for inclusion
160 criteria ($M = 11.73$ weeks, $SD = 6.84$ weeks).

161 Infantry recruit instructors are responsible for training infantry recruits through a 26
162 week Combat Infantryman's Course (CIC). They are all experienced section corporals who
163 are selected to serve a 24 month tenure at a training establishment before returning to their
164 parent unit. The aim of the CIC is to train infantry recruits to the standards required of an
165 infantry soldier to operate as an effective member of a platoon in extremely hostile
166 environments. Infantry training is therefore designed to be both physically and mentally
167 demanding with the majority of instruction and training taking place outdoors and on field
168 exercises. The consequences of failing to meet the required standards at any point in training
169 result in being reallocated to an earlier point in training with another training platoon.

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170 After receiving institutional ethical approval, instructors and recruits were verbally
171 solicited to take part in the study, informed of the nature of the study and the inclusion
172 criteria. Confidentiality was assured and once the inclusion criteria were satisfied, informed
173 consent was obtained. The same conditions for recruitment, participation and assurance of
174 confidentiality were applied to all of the studies in this research program.

175 The instructors were asked to complete the 15 items that were retained from stage 1 for
176 each recruit in their section and asked to rate how well they were able to maintain a high level
177 of personal performance when confronted with different stressful situations in training
178 (example items included “*when the conditions are difficult*” and “*when he has been*
179 *reprimanded or punished*”). Responses were based on a 7-point Likert scale that ranged
180 from 1 (never) to 7 (always), with a midpoint anchor of 4 (sometimes).

181 Results

182 Confirmatory factor analysis (CFA) using LISREL 8.80 (Jöreskog & Sörbom, 2006)
183 was used in an exploratory way to refine the item pool. The fit statistics for the 15 item
184 model was poor ($\chi^2(90) = 511.23, p < 0.01$; RMSEA = .10, CFI = .97, NFI = .96, SRMR =
185 .06, GFI = .80). Post-hoc item refinement was conducted using the standardized residuals,
186 modification indices for theta delta and theoretical rationale. This process identified a
187 number of items that had considerable conceptual overlap with other items, were
188 ambiguously worded, or referred to environmental conditions that may not be a universal
189 stressor. Removal of these items resulted in a six item scale that demonstrated a good fit to
190 the data ($\chi^2(9) = 17.95, p = .04$; CFI = .99, RMSEA = .03, SRMR = .02, NFI = .99, NNFI =
191 .99, GFI = .98). The mean mental toughness score was 4.17 ($SD = 1.30$) with an internal
192 consistency (Cronbach’s alpha) of .89. Factor loadings ranged from .72 to .81 (see Table 1
193 for items and descriptives).

194 Stage 2: Structural Validity

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195 The purpose of stage 2 was to confirm the factor structure of the MTMTI on a separate
196 sample.

197 *Participants and Procedure*

198 A total of 156 recruits ($M_{age} = 21.33$, $SD = 2.90$) between weeks 7 and 23 of training
199 ($M = 14.77$ weeks, $SD=6.49$) were reported on by 23 instructors ($M_{age} = 26.87$, $SD = 2.09$)
200 who had served for an average of 8.48 years in the Army ($SD = 2.27$) and had spent an
201 average of 13.30 months as an instructor ($SD = 5.46$) training recruits. Instructors completed
202 the 6-item MTMTI developed in stage 1.

203 **Results**

204 CFA revealed that the fit statistics for the six-item model demonstrated an acceptable
205 fit to the data ($\chi^2(9) = 21.89$; $p < .01$; CFI = .99, RMSEA = .07, SRMR = .03, NNFI = .98,
206 NFI = .98). The mean mental toughness score was 4.11 ($SD = 1.25$) with an internal
207 consistency (Cronbach's alpha) of .91. Factor loadings ranged from .72 to .88.

208 **Study 2: Test-retest Reliability, Concurrent and Predictive Validity**

209 **Method**

210 **Participants**

211 104 recruits ($M_{age} = 22.07$, $SD = 3.92$) took part in Study 2. They were reported on by
212 15 different instructors ($M_{age} = 26.61$, $SD = 2.12$) who had served for an average of 8.70 years
213 in the Army ($SD = 2.08$) and had spent an average of 12.17 months as an instructor ($SD =$
214 5.93). The recruits had been under the supervision of the reporting instructors for an average
215 of 17.95 weeks ($SD = 5.83$).

216 **Instruments**

217 **MTMTI.** The MTMTI developed and validated in Study 1 was used.

218 Concurrent validity of the MTMTI was tested by selecting variables that are theorized
219 to correlate with mentally tough behavior (e.g., self-report mental toughness, self-confidence,

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220 and resilience measures). Predictive validity was tested by assessing the extent to which the
221 MTMTI predicated performance.

222 ***Sport Mental Toughness Inventory.*** The sport mental toughness questionnaire (SMTQ;
223 Sheard et al., 2009) is a 14-item measure that consists of three subscales; confidence,
224 constancy and control. These subscales can be combined to create a global measure of
225 mental toughness. The scale is measured on a 4-point Likert scale anchored at 1 (not at all
226 true) to 4 (very true). Example items include, “*I have what it takes to perform well under*
227 *pressure*” (confidence); “*I am committed to completing the tasks I have to do*” (constancy);
228 and, “*I worry about performing poorly*” (control; reverse scored). CFA has been shown to
229 provide good support for the 3-factor model (Sheard et al., 2009).

230 ***Self-Confidence.*** Self-confidence was measured using a 5-item scale that was
231 developed and validated by Hardy et al. (2010) in a military training context by asking,
232 “*compared to the most confident recruit you know, how would you rate your confidence in*
233 *your ability to....* (e.g., “*...meet the challenges of training*)”. The response format is rated on
234 a 5-point Likert scale anchored at 1 (low) to 5 (high). This scale has been shown to have
235 good psychometric and predictive validity in a military training context (Hardy et al.,).

236 ***Resilience Scale.*** Resilience was measured using a 4-item resilience scale developed
237 specifically for use in a military training context by Hardy et al. (2010). The stem and
238 response format used was the same as the self-confidence scale. Example items include,
239 “*...adapt to different situations in training and be successful*”. This scale has been shown to
240 have good psychometric and predictive validity in a military training context (Hardy et al.,
241 2013).

242 ***Performance.*** Performance was determined by the recruits’ end of course final grades,
243 based on their weekly reports and grades throughout the CIC. This grade is awarded by the
244 platoon commander (Lieutenant or Captain) and ranges from 0 (fail) to 6 (excellent).

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245 **Procedure**

246 To assess test-retest validity, the MTMTI was administered at weeks 20 and 23 of
247 training. The self-report SMTQ, resilience and confidence scales were administered during
248 week 23 of training, and the performance data was collected at the end of training (week 26).

249 **Results**

250 Descriptive statistics and correlations for all study variables are displayed in Table 2.
251 The MTMTI demonstrated a good fit to the data ($\chi^2(9) = 6.81, p = .66$; RMSEA = .00, NNFI
252 = 1.00, CFI = 1.00, SRMR = .01), although this result should be interpreted with caution due
253 to the small sample size.

254 **Test-Retest Reliability**

255 The mean mental toughness score at week 20 was 4.95 ($SD = 1.34$), and the mean score
256 at week 23 was 4.89 ($SD = 1.36$). A paired sample t-test revealed that these means were not
257 significantly different ($t(103) = 0.63, p = > .05$). The test-retest reliability for the MTMTI
258 was .72.

259 **Concurrent Validity**

260 Table 2 demonstrates that the MTMTI significantly correlated with the global SMTQ (r
261 = .43), the separate subscales of the SMTQ (confidence $r = .37$, constancy $r = .40$, and
262 control $r = .24$), and Hardy et al's. (2010) subscales of resilience ($r = .35$), and confidence (r
263 = .33).

264 **Predictive Validity**

265 Regression analysis revealed that mental toughness significantly predicted individual
266 course performance ($R^2 = .31; \beta = .56, p < .01$). Furthermore, hierarchical regression
267 analyses revealed that the MTMTI accounted for a significant proportion of variance in
268 course performance (Block 2: $\Delta R^2 = .19; \beta = .48, p < .01$) over and above that accounted for
269 by the SMTQ (Block 1: $R^2 = .15; \beta = .19, p < .01$). We also tested whether the MTMTI

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270 accounted for variance in performance after controlling for all the self-report variables used
271 in the current study. The results revealed that the MTMTI accounted for a significant
272 proportion of variance in performance (Block 2: $\Delta R^2 = .18$; $\beta = .48$, $p < .01$) over and above
273 that accounted for by all the self-report measures (Block 1: $R^2 = .17$, $p < .05$).

274 Study 3: Further Test of Predictive Validity

275 Study 2 demonstrated the test re-test reliability, concurrent and predictive validity of
276 the MTMTI. Furthermore the MTMTI was shown to predict performance after controlling
277 for self-reported mental toughness. The aim of Study 3 was to further test the predictive
278 validity of the MTMTI in a specialized infantry context, namely the Parachute Regiment
279 (Para).

280 While initial training for the infantry is necessarily arduous and demanding, initial
281 training for Para recruits is widely regarded by the British Army as being the most physically
282 and mentally demanding of all Infantry regiments in the British Armed Forces (Wilkinson,
283 Rayson, & Bilzon, 2008). Their specialist role requires them to operate at a higher intensity
284 than the regular infantry, carrying heavy loads for longer distances, at a faster pace as well as
285 withstanding the hardships of operating independently in the field for long periods under
286 harsh environmental conditions (Wilkinson et al., 2008). To determine their suitability for
287 this role, at week 20 of the CIC Para recruits are required to undergo a pre-Para selection test-
288 week (PPS), known colloquially as P-Company. P-Company consists of a series of
289 physically demanding team and individual events that involve carrying personal equipment
290 weighing 20kg or more for distances of up to 32km over severe terrain with time constraints,
291 a steeplechase assault course and aerial confidence course. Two team events require the
292 participants to run with a 60kg log and 80kg stretcher for 2.5km and 8km respectively. Pass
293 rates typically range between ~40-70%.

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294 Furthermore, the nature of the military performance indicators is such that they tend to
295 be very physical in nature. However, whilst a specific level of fitness is required for military
296 service, the various tests are designed to assess recruits abilities to perform under stressful
297 and arduous conditions. That is, it is not just fitness that determines the quality of a Para
298 recruit but the ability to maintain a high level of performance in stressful and arduous
299 conditions. Success on P-Company entitles a recruit to wear the coveted maroon beret and
300 pass out of training into a Parachute Regiment unit. Conversely, failure results in the recruit
301 being reallocated to a platoon earlier in the training cycle or transfer to another infantry
302 regiment. The recruits have been training for this test week for the preceding 20 weeks.

303 It is hypothesized that fitness will predict performance on P-Company but, more
304 importantly, mental toughness will predict variance in performance on P-Company after
305 controlling for fitness.

306 Method**307 Participants**

308 Participants for Study 3 were 134 Para recruits ($M_{age} = 19.95$, $SD = 4.14$) who were
309 reported on by 20 different Para recruit instructors ($M_{age} = 28.71$ years, $SD = 2.92$) who had
310 served for an average of 10.65 years in the Army ($SD = 2.63$) and had spent an average of
311 10.95 months as an instructor ($SD = 4.87$). The recruits had been under the supervision of
312 their respective instructors for between 7 and 20 weeks ($M = 15.31$ weeks, $SD = 4.06$).

313 Instruments**314 *Mental Toughness***

315 The MTMTI was used to measure mental toughness.

316 *Performance*

317 During P-Company, participants can achieve a maximum of 70 points, determined by
318 their performance on each event (i.e., up to 10 points for each of the 7 events; the aerial

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319 confidence course is a pass or fail test). Most of the points are awarded objectively based on
320 time to complete or completion of an event and are awarded by P-Company staff who are
321 independent of the recruits' regular training team. Performance scores in the current sample
322 ranged from 10-70 ($M = 49.95$, $SD = 15.07$).

323 Fitness

324 An objective measure of fitness was used to control for individual fitness. During
325 training, recruits are required to complete physical assessments to measure progression in
326 individual fitness. One of these assessments is a two-mile loaded run in less than 18 minutes,
327 carrying a 16 kg pack and rifle. Another assessment is a timed run over a steeplechase
328 assault course consisting of several dry and water obstacles. Each event generates an
329 individual time. Two-mile loaded times for this cohort ranged from 15 minutes and 30's to
330 22 minutes and 47's ($M = 18:39$, $SD = 1:37$). The steeplechase times ranged from 18
331 minutes 30's to 22 minutes 26's ($M = 20:19$, $SD = 1:08$). In order to create an overall
332 indication of fitness these times were standardized within event and were then combined to
333 create an overall score. We then multiplied the overall score by -1 so that a higher score was
334 indicative of better performance.

335 Procedure

336 The fitness tests were conducted during week 18 of training and the MTMTI was
337 administered at the end of week 19 of training. P-Company was conducted at week 20 of
338 training.

339 Results

340 Descriptive statistics and correlations for all study variables are displayed in Table 2.
341 Consistent with Studies 1 and 2, the MTMTI demonstrated a good fit to the data ($\chi^2(9) =$
342 14.07 , $p = 0.12$; $RMSEA = .06$, $NNFI = .99$, $CFI = 1.00$, $SRMR = .03$). The mean mental

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343 toughness score was 4.94 ($SD = 1.02$) with an internal consistency (Cronbach's alpha) of .87.

344 Factor loadings were all above .63.

345 Regression analysis revealed that mental toughness significantly predicted individual P

346 Company performance ($R^2 = .14$; $\beta = .36$, $p < .01$). Moreover, hierarchical regression

347 analysis revealed that MTMTI predicted variance in performance (Block 2: $\Delta R^2 = .06$, $\beta =$

348 $.26$, $p < .01$) over and above that accounted for by the fitness measure (Block 1: $R^2 = .15$, $\beta =$

349 $.30$, $p < .01$).

350 Discussion

351 The purpose of the present series of studies was to develop and validate a measure of

352 mentally tough behavior in a military training environment. Study 1 found good support for

353 the structural validity of the MTMTI, while Study 2 found support for the concurrent,

354 predictive, and test retest reliability. The predictive validity of the MTMTI was further

355 supported in a specialized infantry sample. Moreover, the predictive validity tests

356 demonstrated that the MTMTI predicted objective performance while controlling for another

357 measure of mental toughness (SMTQ in Study 3) and fitness (in Study 4). Overall, the

358 MTMTI demonstrated good psychometric properties across 4 separate samples and the

359 predictive validity was supported in two separate samples. Consequently, these results

360 provide some further support for Hardy et al.'s (2013) proposal that mental toughness should

361 be assessed via observer rather than self-report ratings.

362 The current research is an important first step in developing a valid measure of mental

363 toughness in a military context. Having a valid scale that stands up well to both

364 psychometric and predictive testing allows researchers to examine mental toughness both

365 from applied and theoretical perspectives that will help to further our understanding of

366 mentally tough behavior. For example, the current measure will allow for further exploration

367 of the neuropsychological underpinnings of mentally tough behavior across contexts.

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368 Namely, whether Hardy et al. (2013) counter intuitive finding that mentally tough behavior
369 was related to high levels of punishment sensitivity and low levels of reward sensitivity in
370 cricketers (see Gray & McNaughton, 2000 for a review of reward and punishment sensitivity,
371 and Hardy et al., for a description of how reward and punishment sensitivities might be
372 related to mental toughness). It would seem prudent to examine these results across different
373 contexts.

374 Based on the findings from Hardy et al. (2014), Bell et al. (2013) developed a
375 successful multimodal intervention that was designed to impact mental toughness in elite
376 level cricketers. Consequently, the MTMTI could potentially be used to conduct similar
377 interventions to evaluate mental toughness in a military training environment. The
378 intervention contained three main components; exposure to punishment conditioned stimuli,
379 coping skills training, and was delivered in a transformational manner. Whilst the results of
380 the intervention indicated that it was successful in developing mental toughness by the
381 authors own admission, no attempt was made to measure the separate effects of the
382 punishment conditioned stimuli, the transformational delivery, or the efficacy of the coping
383 skills. Thus, no conclusions can be inferred regarding which aspects of the intervention
384 contributed most to the observed change in mental toughness, or indeed, whether these
385 aspects interacted to impact the observed change in mental toughness. Consequently, further
386 research is needed to delineate more precisely the effects that punishment conditioned
387 stimuli, transformational delivery, and coping skills has on the development of mental
388 toughness.

389 Whilst the current measure has been demonstrated to perform well in the standard
390 tests of measurement efficacy it is noted that the scale is one-dimensional, that is, all the
391 stressors fall under one global aspect. It is suggested that it might be possible to delineate the
392 stressors into clusters. For example, some of the stressors identified in the MTMTI may fall

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393 under physical stress (e.g., tiredness) whilst others about threats to ego (e.g., punishments).
394 Further investigation of this would seem warranted. For example, all of the social pressure
395 items (e.g., “he is not getting on with other section members”) were deleted at stage 1 due to
396 inadequate fit. Indeed, the inclusion of a multidimensional aspect to the measurement of
397 mentally tough behavior will allow for a closer examination of the construct of mental
398 toughness. This would allow for more in-depth questions around mental toughness to be
399 examined, such as, whether some individuals are better able to cope with certain types of
400 stressors than other types of stressors (e.g., social stressors, threats to ego, physical stressors
401 etc.). Furthermore, the role that underlying personality dimensions have in determining
402 individual differences in ability to cope with different types of stressors would also be a
403 worthwhile area of future research. However, in order to test these and other related questions
404 one would need to develop a multidimensional measure of mentally tough behavior. A further
405 limitation and area worthy of future research is to explore the possibility of whether the
406 current anchors should be more reflective of behaviors rather than a Likert type scale.

407 To sum up the current series of studies have gone some way toward developing and
408 validating a measure of mental toughness in a military training environment that will
409 hopefully stimulate further theoretical and applied research in this area.

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References

- 414 Andersen, M. B. (2011). Who's mental, who's tough and who's both? Mutton constructs
415 dressed as lamb. In D. F. Gucciardi and S. Gordon (Eds.), *Mental toughness in*
416 *sport: Developments in theory and research* (pp. 69-88). Oxon: Routledge.
- 417 Bell, J., Hardy, L., & Beattie, S. (2013). Enhancing mental toughness and performance
418 under pressure in elite young cricketers: A 2 year longitudinal intervention. *Sport,*
419 *Exercise, and Performance Psychology, 2*, 281-297. DOI:10.1037/a0033129
- 420 Bull, S. J., Shambrook, C. J., James, W., & Brookes, J. E. (2005). Towards an
421 understanding of mental toughness in elite English cricketers. *Journal of Applied*
422 *Sport Psychology, 17*, 209-227. DOI: 10.1080/10413200591010085
- 423 Clough, P., Earle, K., & Sewell, D. (2002). Mental toughness: The concept and its
424 measurement. In I Cockerill (Ed.), *Solutions in sport psychology* (pp. 32-43).
425 London: Thompson.
- 426 Connaughton, D., Wadey, R., Hanton, S., & Jones, G. (2008). The development and
427 maintenance of mental toughness: Perceptions of elite performers. *Journal of Sports*
428 *Sciences, 26*, 83-95. DOI:10.1080/02640410701310958
- 429 Coulter, T. J., Mallett, C. J., & Gucciardi, D. F. (2010). Understanding mental toughness
430 in Australian soccer: Perceptions of elite performers. *Journal of Sports Sciences, 28*,
431 699-716. DOI:10.1080/02640411003734085
- 432 Crust, L., & Azadi, K. (2010). Mental toughness and athletes' use of psychological
433 strategies. *European Journal of Sport Science, 10*, 43-51. DOI:
434 10.1080/17461390903049972
- 435 Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and
436 passion for long term goals. *Journal of Personality and Social Psychology, 92*, 1087-1101.
437 DOI: 10.1037/0022-3514.92.6.1087

MILITARY TRAINING MENTAL TOUGHNESS INVENTORY

- 438 Gray, J. A., & McNaughton, N. (2000). *The neuropsychology of anxiety: An enquiry into*
439 *the functions of the septo-hippocampal system*. Oxford, UK: Oxford University
440 Press.
- 441 Gucciardi, D. F., & Gordon, S. (2009). Development and preliminary validation of the
442 Cricket Mental Toughness Inventory. *Journal of Sports Sciences, 27*, 1293-1310.
443 DOI:10.1080/02640410903242306
- 444 Gucciardi, D. F., Gordon, S., & Dimmock, J. A. (2009a). Development and preliminary
445 validation of a mental toughness inventory for Australian football. *Psychology for*
446 *Sport and Exercise, 10*, 201-209. DOI:10.1016/j.psychsport.2008.07.011
- 447 Gucciardi, D. F., Gordon, S., & Dimmock, J. A. (2009b). Evaluation of a mental toughness
448 training program for Australian footballers: 1. A quantitative analysis. *Journal of*
449 *Applied Sport Psychology, 21*, 307-323. DOI:10.1080/10413200903026066
- 450 Gucciardi, D. F., Hanton, S., & Mallet, C. L. (2012). Progressing measurement in mental
451 toughness: A case example of the Mental Toughness Questionnaire 48. *Sport,*
452 *Exercise, and Performance Psychology, 1*(13), 194-214. DOI:10.1037/a0027190.
- 453 Hammermeister, J., Pickering, M., & Lennox, A. (2011). Military applications of
454 performance, psychology methods and techniques: An overview of practice and
455 research. *The Journal of Performance Psychology* [e-journal], 3. Available through:
456 Centre for Performance Psychology [Accessed 28th January 2013].
- 457 Hardy, L., Arthur C.A., Jones, G., Shariff, A., Munnoch, K., Isaacs, I., Allsopp, A.J. (2010).
458 The relationship between transformational leader behaviors, psychological, and
459 training outcomes in elite military recruits. *The Leadership Quarterly, 21*, 20-32.
460 DOI:10.1016/j.leaqua.2009.10.002.
- 461 Hardy, L., Bell, J., & Beattie, S. (2014). A neuropsychological model of mentally tough
462 behaviour. *Journal of Personality, 8*, 69-81. DOI: 10.1111/jopy.12034

MILITARY TRAINING MENTAL TOUGHNESS INVENTORY

- 463 Jones, G., Hanton, S., & Connaughton, D. (2002). What is this thing called mental
464 toughness? An investigation of elite sport performers. *Journal of Applied Sport*
465 *Psychology, 14*, 205-218. DOI:10.1080/10413200903026066
- 466 Joreskog, K. G., & Sorbom, D. (2006). *Lisrel 8 (version 8.0)*. [Computer software].
467 Chicago: Scientific Software International.
- 468 Kelly, D. R., Mathews, M. D., & Bartone, P. T. (2014). Grit and hardiness as predictors of
469 performance among West Point cadets. *Military Psychology, 26*, 327-342.
470 doi.org/10.1037/mil0000050
- 471 Kobasa, S. C. (1979). Stressful life events, personality, and health: An inquiry into hardiness. *Journal*
472 *of Personality and Social Psychology, 37*, 1–11. DOI: 10.1037/0022-3514.37.1.1
- 473 Loehr, J. E. (1986). *Mental toughness training for sports: Achieving athletic excellence*.
474 Lexington, MA: Stephen Greene.
- 475 Maddi, S. R. (2006). Hardiness: The courage to grow from stresses. *Journal of Positive Psychology,*
476 *1*, 160–168. DOI: 10.1080/17439760600619609
- 477 Maddi, S. R. (2007). Relevance of hardiness assessment and training to the military context. *Military*
478 *Psychology, 19*, 61–70.
- 479 Maddi, S. R., Mathews, M. D., Kelly, D. R., Villareal, B., & White, M. (2012). The role of hardiness
480 and Grit in predicting performance and retention of USMA cadets. *Military Psychology,*
481 *24*, 19-28. DOI: 10.1080/08995605.2012.639672
- 482 Middleton, S. C., Marsh, H. W., Martin, A. J., Richards, G. E., & Perry, C. (2004).
483 Developing the mental toughness inventory. *Self Research Centre Biannual*
484 *Conference, Berlin*.
- 485 Middleton, S. C., Marsh, H. W., Martin, A. J., Richards, G. E., & Perry, C. (2005).
486 Developing a test for mental toughness: The mental toughness inventory. *AARE*
487 *Conference, Sydney*.
- 488 Sheard, M., Golby, J., & van Wersch, A. (2009). Progress toward construct validation of the

MILITARY TRAINING MENTAL TOUGHNESS INVENTORY

- 489 sports mental toughness inventory (SMTQ). *European Journal of Psychological*
490 *Assessment*, 25, 186-193. DOI 10.1027/1015-5759.25.3.186
- 491 Wilkinson, D. M., Rayson, M. P., & Bilzon, J. L.J. (2008). A physical demands analysis of
492 the 24-week British Army Parachute Regiment recruit training syllabus. *Ergonomics*,
493 *51*, 649-662. DOI: 10.1080/00140130701757367

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Table 1.
Standardized factor loadings, means and standard deviations for retained items.

4		Study 1a (<i>n</i> = 279)		Study 1b (<i>n</i> = 156)		Study 2 (wk 20) (<i>n</i> = 104)		(Study 2 wk 23)		Study 3 (<i>n</i> = 134)	
		FL	M (SD)	FL	M (SD)	FL	M (SD)	FL	M (SD)	FL	M (SD)
1	His recent performances have been poor.	0.72	4.23(1.50)	0.82	4.08(1.52)	0.64	4.57(1.82)	0.86	4.95(1.40)	0.63	4.81(1.26)
2	He is in pain (e.g., associated with high levels of physical effort).	0.77	4.06(1.78)	0.74	3.98(1.59)	0.75	4.86(1.76)	0.87	4.89(1.60)	0.66	4.78(1.48)
3	The conditions are difficult (e.g., on exercise).	0.80	4.22(1.55)	0.88	4.12(1.49)	0.82	5.05(1.55)	0.90	4.91(1.58)	0.87	5.00(1.22)
4	He has been reprimanded/punished	0.81	4.06(1.68)	0.75	4.41(1.61)	0.82	5.11(1.56)	0.83	4.90(1.51)	0.69	5.06(1.19)
5	He has not had much sleep	0.74	4.04(1.51)	0.82	3.87(1.36)	0.85	4.95(1.50)	0.85	4.79(1.52)	0.80	4.78(1.24)
6	He is under pressure to perform well (e.g., assessments, test conditions)	0.73	4.41(1.62)	0.72	4.22(1.53)	0.79	5.23(1.65)	0.84	4.88(1.58)	0.75	4.92(1.36)
	Total Mental Toughness		4.17(1.30)		4.11(1.25)		4.95(1.34)		4.89(1.36)		4.89(1.01)

Note. FL is the standardized factor loading

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Table 2. Means, SDs, and inter-correlations between variables in studies 2 and 3 with alpha coefficients in parentheses

	Mean	SD	1	2	3	4	5	6	7	8	9
Study 2 (n = 104)											
1 Mental Toughness (wk 20)	4.95	1.34	(.90)								
2 Mental Toughness (wk 23)	4.89	1.36	.72**	(.94)							
3 SMTQ	2.98	0.40	.33**	.43**	(.78)						
4 SMTQ-Confidence	3.08	0.48	.27**	.37**	.83**	(.66)					
5 SMTQ-Constancy	3.38	0.45	.31**	.40**	.75**	.51**	(.45)				
6 SMTQ-Control	2.42	0.61	.20*	.24*	.74**	.33**	.40**	(.62)			
7 Resilience	3.94	0.70	.32**	.35**	.68**	.62**	.52**	.46**	(.81)		
8 Self-confidence	4.12	0.63	.25**	.33**	.71**	.72**	.52**	.38**	.75**	(.85)	
9 Final Course Grade	4.05	1.57	.33**	.56**	.39**	.33**	.39**	.23*	.33**	.35**	
Study 3 (n = 134)											
	Mean	SD	1	2	3						
1 Mental Toughness	4.89	1.01	(.87)								
2 P Company Score	47.25	17.63	.36**								
3 Fitness Score	0.03	0.74	.43**	.42**							

** $p < .01$ * $p < .05$

Appendix A

Military Training Mental Toughness Questionnaire – MTMTI

Please think about each recruit and how he **GENERALLY** performs during training. The following questions ask you to rate how often the recruit is able to maintain a high level of **personal performance**, even when he is faced with demanding situations during training. Please consider each scenario individually and circle the number you think is most appropriate.

Student Army Number. _____ **Weeks under your Instruction:** _____

HE IS ABLE TO MAINTAIN A HIGH LEVEL OF PERSONAL PERFORMANCE, EVEN WHEN:

		Never		Sometimes			Always	
1	His recent performances have been poor	1	2	3	4	5	6	7
2	He is in pain (e.g., associated with high levels of physical effort).	1	2	3	4	5	6	7
3	The conditions are difficult (e.g., on exercise).	1	2	3	4	5	6	7
4	He has been reprimanded/punished	1	2	3	4	5	6	7
5	He has not had much sleep	1	2	3	4	5	6	7
6	He is under pressure to perform well (e.g., critical assessments/being observed)	1	2	3	4	5	6	7